producing a change in the output of the transducer which was indistinguishable from variations due to gain stability and zero stability.

Eight of these isotonic transducers have been used for teaching and research in this department for 3 months and no breakdowns have yet occurred. The tissue can be connected directly to the moving core of the LVDT (weight 5 g), counterbalance being provided by a weighted pulley system above the core, or more usually through a conventional isotonic lever system which can provide the necessary demagnification of the response from the tissue where this is greater than 1·5 cm This system has been used successfully on a variety of tissues including rabbit, rat and guinea-pig intestine (for conventional and also cumulative dose-response curves), transmurally stimulated guinea-pig vas deferens, rabbit and rat uteri, phrenic nerve-diaphragm and guinea-pig atria. With the latter two preparations "bounce" and the harmonics of the recording system can cause problems as they do with any isotonic recording from these tissues.

The total cost of the components and case for the complete transducer and power supply is £19 15s 0d, the most expensive item being the LVDT (type E300D; cost £13) which was obtained from Electromechanisms Ltd., of Slough.

This isotonic transducer will drive satisfactorily most pen recorders and provides an effective and inexpensive way of replacing the smoked drum.

Department of Pharmacology,
The Medical School,
Thoresby Place,
Leeds LS 2 9NL,
Yorkshire.

D. M. HANNON
I. E. HUGHES
E. LETLEY

January 9, 1970

Effects of a marihuana homologue (Pyrahexyl) on avoidance learning in the gerbil

Pyrahexyl (synhexyl, 3-hexyl-7,8,9,10-tetrahydro-6,6,9-trimethyl-6*H*-dibenzo[*b*,*d*] pyran-1-ol) is a synthetic cannabis compound having behavioural effects similar to tetrahydrocannabinol (THC) one of the active principles of *Cannabis sativa* L (Hollister, Richards & Gillespie, 1968). Although pyrahexyl has been studied in man (Stockings, 1947; Parker & Wrigley, 1950; Thompson & Procter, 1953; Hollister & others, 1968), little is known of its specific behavioural effects except that it seems to have euphoriant properties. Recently, Abel (1969) found in rats that pyrahexyl markedly reduced the amount of time required to resume lever pressing for water after this activity had been suppressed by a fear-producing stimulus and Abel & Schiff (1969) reported that pyrahexyl increased "curiosity" in rats as measured by the time they spent observing other animals. We now report its effect in an avoidance learning situation. The particular testing procedure chosen assessed the effect of pyrahexyl on the acquisition of new behaviour rather than its effect upon a previously learned response as examined by Abel (1969).

Six adult male Mongolian gerbils (*Meriones Unguiculatus*), 80–90 g, were injected intraperitoneally with 0·2 ml of a solution of pyrahexyl (2·3 mg/kg) in olive oil; six control animals received only oil injections. After 2 h animals were placed individually into a standard two-compartment automated shuttle box (Lehigh Valley Electronics, Model 146–04) in which they could avoid being shocked through the grid floor by jumping over a barrier dividing the apparatus. An auditory signal was the conditioned stimulus and a 0·8 mA constant current electric shock the unconditioned stimulus. The conditioned stimulus preceded the onset of shock by

5 s. If an avoidance response was not made during this period, shock came on and remained on until the animal jumped over the barrier. Each presentation of the conditioned stimulus and the performance of a jumping response constituted a single trial; 50 such trials were given each day with a 25 s interval between trials. A total of 250 trials was given over a 5-day test period. The test apparatus and recording equipment were completely automated and the animals were not disturbed once the daily test period had begun. Records were kept of the number of successful trials; the time taken to jump the barrier after each conditioned stimulus onset (jump latency); and the number of between trial jumps which were not associated with the conditioned stimulus.

As shown in Fig. 1A, pyrahexyl-injected animals made more avoidance responses on the first day of testing than did control animals; this difference was statistically significant (*t*-test, Edwards, 1964; $t = 1{\cdot}89$, $P<0{\cdot}05$). By the second test day all animals had achieved high performance levels and no differences in acquisition of the avoidance response were found between groups on this or any subsequent day. However, analysis of variance (Edwards, 1964) showed that, compared to controls pyrahexyl-injected animals had significantly lower response latencies to the conditioned stimulus throughout the five day test period ($F = 11, 21$, df, 1, 10, $P<0{\cdot}01$, see Fig. 1B). There was no effect of the drug on responding independent of presentation of the conditioned stimulus ("between-trial" jumps). The mean daily between-trial jump rates were: pyrahexyl animals, $\bar{X} = 12{\cdot}19$, range 2·8–47; control animals, $\bar{X} = 14{\cdot}32$, range 4·0–50.

Thus, at the dosage level employed, pyrahexyl affected the acquisition of an active avoidance response in its earliest stages; the effect being confined to the first day of testing. It is likely that the effect was obscured on the remaining four test days because of the rapid learning of the control group during this period. However,

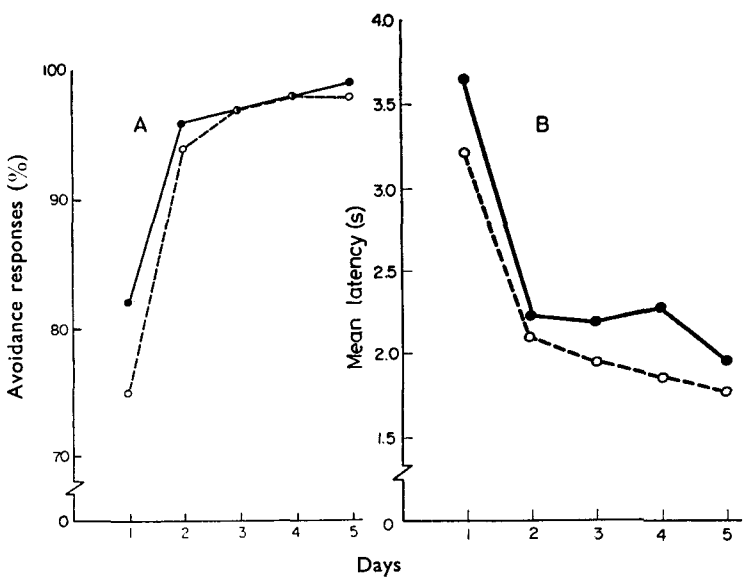

FIG. 1. A. Shock avoidance learning in gerbils given i.p. injections of 2·3 mg/kg pyrahexyl (●—●) and oil injected controls (○—○). Each point represents the mean percent avoidance responses over 50 trials on each of five days.

B. Mean jump latency in response to 5 s auditory warning signal during avoidance conditioning. Each point represents the mean time taken to jump a barrier over 50 trials on each of five days. ●—● Controls. ○—○ Drug.

performance was significantly affected by the drug on all test days since pyrahexyl-injected animals responded to the conditioned stimulus much more quickly than did control animals. This does not appear to be directly attributable to any drug-induced increase in general activity since there were no differences between groups in their between-trial jumping behaviour.

One possible interpretation of these data is that pyrahexyl can serve to increase the probability of a dominant response which would normally occur in a given situation. For example, after a thirsty animal has learned to depress a lever for water, the probability of lever-pressing following water deprivation is very high. However, this behaviour can be inhibited by inducing a conditioned fear reaction in the animal by presenting a tone which has previously been paired with an electric shock. Under such conditions Abel (1969) found that pyrahexyl reduced the time required for thirsty animals to resume lever-pressing for water reward and hypothesized that the drug served to reduce the degree of fear thereby lessening the inhibitory properties of this conditioned fear response.

Another interpretation of these data is that pyrahexyl in some manner facilitates the emission of the dominant response, viz., lever pressing. This has been supported by Abel & Schiff (1969) who found that when rats were placed in a box in which they could either observe other stimulus animals or explore the box, they spent most of their time observing other animals. Thus, the dominant behaviour in this situation was a specific observational response. When pyrahexyl was administered in this situation it was found that drug-injected animals spent even more time observing animals thus suggesting a preservation of a dominant response by the drug.

We found that once the animals had learned to avoid shock by jumping the barrier in the presence of the conditioned stimulus, the dominant response became jumping. Both groups of animals learned this response at about the same rate, but the response was consistently emitted much sooner in the animals given pyrahexyl. This suggests that the probability of making a prepotent response is increased under the influence of pyrahexyl. Therefore, our results may be viewed as offering further experimental support for the dominant response hypothesis.

This work was supported by research grants to G. C. Walters from the National Research Council of Canada (APA–161) and the Ontario Mental Health Foundation (No. 107). We thank Drs. B. B. Schiff and P. D. Cooper of the University of Toronto for supplying the pyrahexyl and Mr. Michael Kocal for technical assistance in testing the animals. E. L. Abel is now at the Department of Poultry Husbandry, University of California, Berkeley, California, U.S.A.

Department of Psychology,
University of Toronto,
Toronto 5, *Ont., Canada.*
November 10, 1969

GARY C. WALTERS
ERNEST L. ABEL

REFERENCES

ABEL, E. L. (1969). *Psychon. Sci.*, **16**, 44.

ABEL, E. L. & SCHIFF, B. B. (1969). *Ibid.*, **16**, 38.

EDWARDS, A. L. (1964). *Experimental Design in Psychological Research.* Toronto: Holt, Rinehart & Winston.

HOLLISTER, L. E., RICHARDS, R. K. & GILLESPIE, H. H. (1968). *Clin. Pharmac. Ther.*, **9**, 783–791.

PARKER, C. S. & WRIGLEY, F. (1950). *J. ment. Sci.*, **96**, 276–279.

STOCKINGS, G. T. (1947). *Br. med. J.*, **1**, 918–922.

THOMPSON, L. J. & PROCTER, R. C. (1953). *N. Carolina med. J.*, **14**, 520–523.